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Information Technology

Computers help chemical producers fortify customer operations
Page 29

CHEMICAL & ENGINEERING
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NOVEMBER 18, 1991

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News of the Week

■ **Biotechnology firms take advantage of favorable investment climate by flooding stock market with offerings.** **Page 6**

■ **Nuclear fusion experiment at Joint European Torus in the U.K. generates record amount of power, using deuterium-tritium fuel for first time in a magnetic-confinement fusion test.** **Page 6**

■ **New CanSolv technology from Union Carbide uses thermally regenerable organic amine salt to remove sulfur dioxide from flue gas.** **Page 7**

■ **W. R. Grace adopts new corporate strategy calling for selling off nonstrategic businesses, including organic chemicals unit, and focusing on specialty chemicals and health care businesses.** **Page 8**

■ **OSHA proposes lowering methylene chloride exposure limits in response to concerns over chemical's toxicity and possible carcinogenicity.** **Page 8**

Cover: Sales representative accesses sales data on portable computer during warehouse walk-through. Photo courtesy of FMC

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Business

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BP Chemicals unit develops oxygenated solvents that may replace chlorofluorocarbons used in cleaning printed circuit boards. **Page 16**

Government

Allowance trading system for acid rain pollution proposed by EPA would permit electric utilities, other groups to buy, sell, or bank rights to emit sulfur dioxide. **Page 20**

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Science/Technology

Analytical lab equipment show aimed at West Coast markets featured extensive exposition, mini short courses. **Page 24**

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Product Report

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LETTERS

Reanalyzing old extracts

The letter to the editor, "Error in dioxin data" (C&EN, Oct. 7, page 3) suggests that reanalyzing old extracts from water, soil, biota, or human tissue might provide definitive analytical data. However, the letter is silent on the issue of storage stability of the chemicals. Without proper assessment of this issue, one has to wonder about the use of concentration data of chemicals in extracts from the 1970s and 1980s.

The letter further asserts that in the late 1970s and 1980s, the Environmental Protection Agency had a program to save sample extracts for future analysis using "new emerging analytical chemistry methodologies." But who decides if the new methodologies have matured enough to analyze the old extracts? Keeping the extracts as a requirement for Superfund or effluent guideline related work has more to do with legal evidence for a potential litigation than with analyzing the extracts after 20 years to verify or disprove initial concentration results.

Without experimental data about the storage stability of chemicals in extracts, the reanalysis of extracts of water, soil, and so on would, in my mind, be an exercise in futility. The storage stability of chemicals, if not known or determined, raises serious questions about the accuracy and validity of results obtained from old extracts. This will be in the limelight when, as the letter states, "the use of the data is for legal purposes and is of high public interest, such as the dioxin case."

John Mathew
Hazleton Wisconsin Inc.
Madison, Wis.

Research on asphalt

In Robert Dunning's letter (C&EN, Sept. 30, page 5) he questions whether chemists have had sufficient influence on the work that the Strategic Highway Research Program (SHRP) is doing to improve asphalt performance. He also implies that valuable previous work has been ignored. Both impressions are incorrect. The facts are as follows.

The U.S. spends more than $10 billion a year on asphalt pavements. The specifications that are now used to control this massive investment do not ensure good performance—whether the asphalt cracks in cold temperatures, forms ruts in the wheel paths under heavy loads at high temperatures, or forms fatigue cracks under repeated loading cycles. As a result, premature distress is a common sight on U.S. asphalt pavements.

Taxpayers would be well served if the public agencies that build asphalt pavements were able to select materials and designs with more direct control over how these materials will actually perform. Highway agencies recognized this, and in 1987 established SHRP's $50 million program of research on asphalt to find better ways to manage this. SHRP is a thorough, scientific exploration by chemists, chemical engineers, civil engineers, materials scientists, geologists, and others who have expertise on this important subject. Of the approximately 150 scientists and engineers involved in SHRP's asphalt research, about 60 are chemists and chemical engineers. Chemical expertise certainly has not been overlooked, as Dunning argues.

Dunning believes that some specialists—apparently himself included—have known all along how asphalt chemistry affects performance, and how to exploit that knowledge in the selection of materials that will perform well. Some may have speculated about the causes of performance, but proof was certainly lacking. In hundreds of scientific papers reviewed by our research team in the course of its work, and in consultation with the world's experts on this subject, we have found many competing and conflicting explanations in past chemical research literature, none of which adequately explained asphalt's viscoelastic properties. Many believed that micellar structures were key. A few may even have speculated upon the possibility that bifunctional or polyfunctional polar groups were important constituents. However, this last hypothesis was never fully tested nor proven out until SHRP's research team did so, and showed that amphoterics are critical in explaining the viscoelastic properties of asphalts.

Dunning also challenges whether or not the same specifications can cover both neat asphalt and polymer-modified asphalts. While he is correct in pointing

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IBM photo

Chemical Industry Counts on Information Technology To Enhance Customer Service

Susan J. Ainsworth, C&EN Houston

It's no secret that the chemical industry has been slower than most to embrace the full potential of information technology. But chemical companies are becoming increasingly aware of how to use these systems to their competitive advantage.

The chemical industry spends an average 1.8% of its revenues on information systems, compared with 2.2% for all industries, according to an early 1991 survey of 35 North American chemical companies conducted by the management consulting firm Index Group Inc., of Cambridge, Mass. That same survey found that major North American chemical companies planned to increase their computer and communications technology budgets an average of only 3.2% in 1991, concentrating their efforts in the customer-focused areas of order processing, inventory, and manufacturing operations. In contrast, other industries planned to boost their information technology budgets about 5.3%, says Index.

To be sure, the current recession, the downward turn in the chemical business cycle, and the Persian Gulf crisis are having a crippling effect on many chemical companies as evidenced by the recent rash of asset cuts, employee layoffs, and cost-reducing measures. Consequently, these factors are having a negative impact on spending on information systems within chemical companies as well.

"After years of industry expansion, many chemical companies are concerned about the economic conditions and the effect [they will have] on both commodity and specialty chemicals profitability," says Thomas A. Nickles, an Index vice president. That means prudent use of information technology is becoming critical, say industry sources. Adds Nickles: "Information systems departments in these companies find that being responsive and cost-effective in the introduction and delivery of new technologies are paramount."

Although chemical companies are cutting assets, employees, and costs, "we've not heard anyone say they want to sell less, deliver less, or be less visible in the marketplace. A lot of that edge will need to come from technology, and information systems will be one of those technologies. Automation will continue to drive down some costs," says Aldona Valicenti, manager of systems development support for the Amoco Chemical arm of Amoco Corp., which was recently named as this year's most effective user of information systems among petroleum and chemical companies by *Computerworld* magazine.

Indeed, information technology is "even more critical" in economic hard times, says James P. Alampi, senior vice president of administration for Univar Corp., of Seattle, the largest chemical distributor in the U.S. In the past if there had been a problem "or we needed to get something done efficiently, we could always hire more people," notes Alampi. But given today's legal and regulatory climate, it takes longer to train people and "it is getting harder to find good people that don't cause you exposure" to regulations. A way to minimize risk, he says, is by investing in systems that provide the information each employee needs so that very few employees have to be experts in many areas. Systems that provide that type of information make it "easier to live through good times and bad times."

Kenneth M. Arnold, chairman of Datalogix International, the Valhalla, N.Y.-based developer of integrated business software for process manufacturers, says, "The most advanced and forward-thinking companies will take advantage of the fact that business is slow now so companies have the time, attention, and people to [implement information systems] right." Information technology "can streamline operations, but it also costs money and takes time to get going before users start to see benefits." At least some chemical companies must be getting the message. Despite the economic downturn, "business at Datalogix has been really good since May," says Arnold.

Still, companies that recognize the benefits of information systems are not spending freely on them. "Projects are receiving more scrutiny today," says Robert Kramer, information resources manager for FMC's Chemical Products Group. "We tell our users to focus on the applications that are most important to keep operations running. We are spending money where it makes the most sense, trying to hold costs down."

Valicenti: a cost-cutting technology

Expenditures that "are not viewed as being directly in support of our customer operation will [probably] fall off priority lists," says Amoco's Valicenti. "Because the chemical industry is operating in an extremely expense-constrained environment, it has to look for those things that will increase efficiency, improve a process, or help it deliver products at a lower cost. I think it's clear that there's just not that much money to spend, so the money you're going to spend will have to provide a bigger bang for the corporation."

Alampi: more critical in hard times

Given that, "one of the things you want to be sure you are able to do is relate what you are doing from an information systems support perspective with the business strategy," adds Valicenti. Many companies seem to be moving in that direction. It's true that many chemical companies are centralizing their staff/support information systems, such as those that handle financial information reporting. But at the same time, they are decentralizing their line operations systems—those relating to their specific business operations.

At Hoechst Celanese, for example, the idea is to make backbone systems, support, or administrative-type systems "as generic as possible across the company so as to run as inexpensively as possible. And [systems used] to order, make, grade, ship, or inventory your product should be driven as close as possible to the manufacturing facility that is producing it," says Edward Phares, vice president of Corporate Information Systems for Hoechst Celanese.

For its part, Amoco Chemical has long set its information technology budget with an eye to business strategy, but now it is taking that a step further. "We continue to negotiate for budget money every year with our chemical company client," says Valicenti, and in order to do that her department must understand Amoco Chemical's business plan. But because "we report directly to the chemical company and are more closely allied with it, we are going to have to take an even closer look at the business strategy. What I hope will happen now is that we will get a link to that strategy even earlier in the cycle," maybe as that strategy is being set.

This kind of early information can sometimes help information systems departments be more effective. For example, if business plans call for the sale or the acquisition of a business, Valicenti says her department can plan ahead to disengage a departing system or integrate new systems. Or if the chemical company is introduc-

Arnold: good time to implement

ing a new product line, she adds, "information technology [managers] ask how we can support the plant [that makes that new product] or the service [component of that new line]. Information technology becomes directly tied to the business."

Another potential benefit to a decentralized information technology is improved teamwork across departments. "If you align your information technology with various business groups and organizations," the business groups take on a greater feeling of ownership for the information technology projects, explains Kramer. At FMC, the responsibility for justifying the funding for an information technology project falls on the business group's steering committee. Thus, the project is viewed as something that can benefit the business group and it takes the same importance as other capital investments.

Phares: a teamwork environment

It used to be that information systems were viewed as a "drain or a necessary evil," says Hoechst Celanese's Phares. But now, at Hoechst Celanese at least, the information systems staff is treated as "a partner to our business counterparts." Those involved in information systems are treated as "team members" who can help make product more efficiently or improve customer or vendor relations, rather than just being "an overhead or a burden. That's a good position to be in." The heads of product lines, for example, are less often complaining about the expense of information technology than they are talking about how these systems are bringing them benefits, he adds. "They want information systems on their team."

This attitude is evident in the "significant investment going on" in information technology at Hoechst Celanese, even while information technology budgets at many chemical companies are being trimmed. The business group leaders have enough "faith and commitment in the information systems staff to believe that it will work with them as a partner to enable them to restructure their business and to be competitive in their marketplace," during economic downtimes, says Phares.

But at the same time, investments in information resources projects should be subjected to the same scrutiny put to other company projects, such as building a new plant, says Kramer. Phares agrees: "You have to run information systems the same way as the guy who is selling fiber or selling commodity chemicals." Information systems heads have to look at how they are staffing their departments, consider where they are putting their investments, and so forth. "Information systems have to be run as a business."

Information technology used to be an overhead type of issue. Managers of these departments "would just keep requesting more money, never looking at the bottom line," Phares says. They would tell senior

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Firms are decentralizing their information technology efforts to streamline operations

As part of their push to operate efficiently during this cost-conscious, recession-weary time, many chemical companies are decentralizing their information technology efforts to bolster their business strategies. At the same time, these companies are also distributing their systems to bring computing power to the desk top, where it can be manipulated and utilized in additional ways.

In the 1980s, "we started seeing [companies] move from central computing platforms, where historically everybody was running off of mainframes, to more distributed processing systems, where you might have minicomputers set up in various divisions within a company," observes Thomas A. Nickles, a vice president of the management consulting firm Index Group, Cambridge, Mass.

"The trend in the 1990s," says Nickles, "is that computerization is really now down to the desk top." More and more of the data, applications, and processing are now getting distributed from what used to be mainframes or distributed minicomputer processors down to personal computers (PCs) and workstations and then onto local area networks (LANS).

Amoco Chemical is a case in point. A few years ago, when PCs started to appear on many desks, they made employees more productive, notes Aldona Valicenti, manager of the company's systems development support. At first, PCs basically gave employees the power to do spread sheets and their own word processing, for example. As the equipment became more sophisticated and easier to use, the employees began to look at how they could make better use of the new level of power on their desks. "So, our migration to LANS was made primarily to share expensive peripherals and files," says Valicenti, "so that more employees could make use of them."

Thanks to this newfound desktop power, applications development and implementation are no longer controlled by and confined to some central group, observes Nickles. Now those tasks are being done on desktop computers, which are still connected to mainframe level computers, he adds.

Although setting up these distributed systems is a challenge, "I think the main issue here is not technological, it's organizational," says Nickles. Rather than just automate the tasks that employees have been doing, this trend is actually "creating job-enriching opportunities for people." For example, with this technology, a clerk can become an analyst, adds Nickles. "There's a lot being written about how the [increased accessibility of data] reduces the need for middle level managers." With this technology change, lower level employees using computers can access the knowledge and information necessary to make the decisions usually reserved for middle management.

"Employees are now comfortable with PCs on their desks. They've developed some applications themselves, and now they are looking at PCs as an intelligent device that allows us to look at data differently than we looked at them before," says Valicenti. PCs, she points out, make it possible to display data more graphically than mainframe systems could by adding color, integrating photos, and other things. Manipulating data in a PC environment can be done "faster, better, and easier," she adds.

Employees becoming comfortable with PCs on their desks

management that they had to buy a certain computer, for example, or they wouldn't be able to compete and "the world would come to an end. But those days are over." Now management is holding information technology departments accountable, he says. "Capital is scarce and that means that information technology departments have to compete against those pushing for other projects that support the operation. And I think that's where we should be. I really do," says Phares.

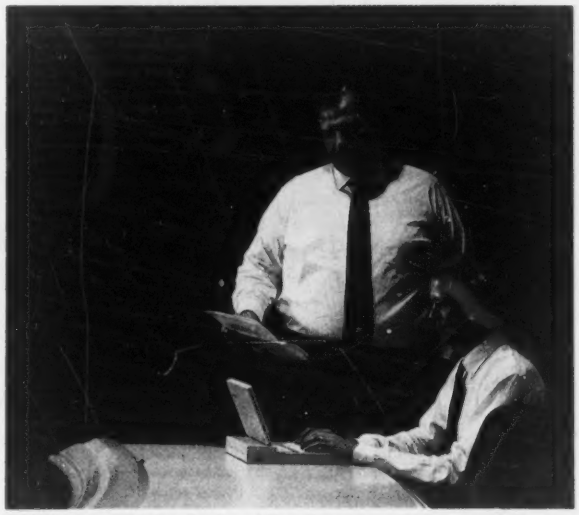
Knowing what information technologies to campaign for is not easy, say information resources managers. It's a tough job to decide how to apply many of the new, interesting computer technologies that keep evolving. "Doing the right things with a limited budget" is a major challenge, says Valicenti.

The choices and options are seemingly endless. "We now have personal computers (PCs) and workstations, which are basically more powerful individual computers, and minicomputers and mainframes and control systems with computers under their covers. Each one of these may be doing a part of an [information technology] solution," says Jon Rietzke, manufacturing industry specialist at IBM's Chemical Industry Center in Philadelphia. "In addition, there are networking facilities that are evolving to allow us to interconnect all kinds of equipment and computers, as well as new ideas such as image management, video, and voice technology, for example." The question for chemical company information systems managers becomes: "How fast can I make use of this technology so that my company can reap the benefits and not be overwhelmed?" says Rietzke.

Indeed, information technology managers must be sensitive to the concept that their companies can't handle too much change too fast, says Valicenti. These managers are no longer outside that realm of prioritizing these changes, she says. Quality programs are already at work at many chemical companies, outdating

Aiming to take advantage of employees' comfort levels with PCs and of the PC's increasing processing power, the idea is to "now move processing as close as we can to the person in control of the data," says Valicenti.

Robert Kramer, information resources manager for FMC's chemical products group, agrees. The group's strategy, Kramer says, is to use the PC "as a tool to connect geographically dispersed users and access data regardless of where it resides." The company is in the process of networking all of its PCs with its Digital Equipment Corp. systems. "What we're trying to do is establish an infrastructure such that where the data reside is immaterial to the person who needs it," Kramer adds.



FMC photo

FMC's Kramer (standing) and Ron Stover use laptop computer to review account reports

Data used by many people might be stored centrally. Data used by employees at a single location might be put on a local processor. And data handled by only one person might reside on a PC until a project is finished, at which time the data would be disseminated throughout the organization, Kramer explains. Creating such an infrastructure means that access to office systems or to centralized data or any information on any type of hardware is achieved through the same platform or the same workstation. As part of this ambitious undertaking, FMC is "trying to build many of our new systems with the same key strokes as our office systems so that a key stroke represents the same function across all applications."

With this infrastructure in place, FMC's sales representatives in the field can access the company's mainframe with their PCs and pull up all they need to know about a customer. The shared information system is part of an FMC project that focuses on improving the productivity of the industrial chemical sales force by automating important administration functions as well as by capturing customer-related information. The PC-based data exchange decreases the company's response time in dealing with the changing needs of its customers and increases the amount of time available to sales representatives for direct customer contact. The use of laptop PCs also streamlines the flow of information from the field to the rest of the organization, says Kramer.

Although PCs are handling more applications, there is still a need in some places for mainframe-based systems. "The mainframe is not dead yet," despite what a lot of people keep proclaiming, Valicenti stresses.

She points out that most large organizations have "lots of data in systems that will stay on a mainframe because the investment is too large" to change it. In addition, data that need to be maintained in a central environment because of the security involved or because of confidentiality will likely continue to reside on a mainframe. For example, "I do not think that Amoco Chemical Co. would want to run its financial system on PCs," Valicenti says.

There are a set of applications that from a security, stewardship, and investment-based perspective are going to remain on a mainframe, notes Valicenti. "But I think that the rest [of the applications] are up for grabs or for questioning as to where [they] should run. I really think [it is] this kind of differentiation that's going to continue to go on across the industry."

established business practices and familiar work patterns. Information technology programs can bring on a certain level of culture shock. New systems, she notes, can drastically change how people think and do their work after years of doing things a certain way.

Indeed, in today's highly competitive and cost-conscious business environment, chemical companies can ill afford not to question the way they conduct their business practices and processes. And more and more companies seem to be doing just that. In the 1980s, chemical companies became preoccupied with pulling together the computer-related, automated applications that were developed independently in the 1970s; the key word was "integration," says Index's Nickles. For example, companies found a great deal of value in integrating technology so that an order could be sent through an order entry system and fulfilled through manufacturing. And chemical companies are far from done in exploiting the benefits of integration; in fact, many companies are just now getting integration projects under way. "But, as we enter the 1990s, we are coming to the realization that integration has to be coupled with the redesign of the business processes," a concept that Index terms reengineering, Nickles says.

When the industry began integrating technologies dealing with customer service, logistics, and manufacturing, for example, "we did not change the basic processes—the way people are doing their work," says Nickles. "If you have a mess and you automate that mess, all you are doing is processing that mess faster," explains Valicenti. In the past, "we've automated systems that are already in place or that have been institutionalized without really reexamining if it is still the correct business practice," she adds. A company can install new hardware and new applications and integrate it all, but that company won't see a fundamental change. It won't get the very dramatic improvements in either time, quality, or eco-

nomics unless it fundamentally changes those business processes, adds Nickles. "But now what we are seeing in the 1990s," he says, "is really an emphasis on changing the business process to reflect a much more integrated set of work."

The concept itself is not necessarily new. What's new is the emphasis. People are talking more than they used to about reengineering. In the past when companies set out to redesign their business process, they did it more "haphazardly," FMC's Kramer says. "Now there are some technologies out there that help you work through this." Companies like Index and Andersen Consulting have put some of these processes in place, he notes.

One tactic Index uses is to work with clients on a cross-functional basis, says Nickles. For example, if it aimed to reevaluate a company's customer service, it would also deal with marketing, sales, logistics, and manufacturing employees "to fundamentally look at how they are doing their work on the business process side."

The trend is taking off because "American companies really have to reposition themselves to compete better in a world market," says Stephen Parkoff, a manager at Coopers & Lybrand, which is also in the business of helping clients redesign their business processes, an undertaking that his firm calls resource productivity analysis.

Many believe in the benefits of the effort. This process helps make a company "leaner and meaner," says Parkoff. "It all boils down to taking a look at business needs and eliminating non-value-added functions." When coming out of a reengineering effort, "I think you end up with a more streamlined business process and organization," says Kramer.

Reengineering can also save companies money on information systems, notes Parkoff. For example, he says, some companies are finding that they are stuck with 20-year-old computer systems that are designed on the basis of the technology and processes in existence two decades ago. Before they lay out $6 million or so to redo their order entry or customer service systems, they may want to first look at the underlying processes. If they can make the processes simpler, eliminate some steps in the way they process an order, or use electronic data interchange to integrate with their customers, for example, it is possible that the new computer systems will be simpler and less costly. "It makes a hell of a lot of sense. That's the kind of dynamics that are going on."

Index's Nickles points up three primary applications of reengineering in the chemical industry. For one, reengineering can be used to look at the way products are developed so as to shorten development cycles. For example, in the pharmaceutical industry, "we can take a process that might take years and try to cut [the development time] in half."

Reengineering is also being used

Computers are used widely in chemical industry . . .

	% of respondees, by job category, using computers[a]
Management	99.3%
Production/control	98.1
Process development/design	96.0
Product research/ development	97.0
Purchasing/sales/service	88.9
Other/not specified	89.5
All users	96.7%

. . . with demand for PCs outdistancing other types

	% of respondees using computer type[a]
Personal computers	92.3%
Graphics workstations	25.3
Small (mini) computers	31.8
Intermediate computers	26.2
Large computers	34.5
Supercomputers	3.3
One or more of the above	96.7

a Based on 600 responses from a sample of 1500 U.S. C&EN readers, largely ACS members. **Source:** Mar% Stat Market Research & Analysis (Eugene, Ore.) for C&EN/CENTCOM, Ltd.

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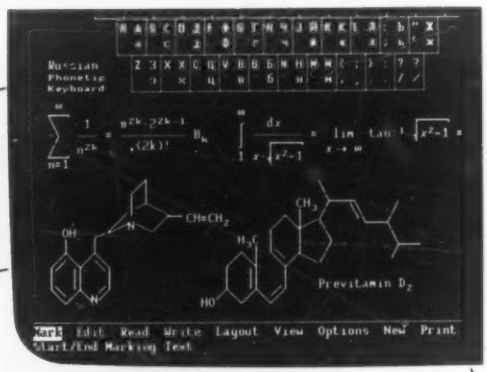

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Chemical industry uses a variety of software

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a Based on 600 responses from sample of 1500 U.S. C&EN readers, largely ACS members. Source: Mar % Stat Market Research & Analysis (Eugene, Ore.) for C&EN/CENTCOM Ltd.

for financial consolidation. In such a project under way now, Hoechst Celanese is looking at "reengineering corporate and other finance and accounting business processes and systems to achieve significantly increased business value," says Phares. "What we are looking to do is eliminate functions whose only purpose is to facilitate and coordinate information; replace specialized assembly-line processes with generalized end-to-end functions; simplify organizational responsibilities around business processes; and enhance data accessibility and ease of use of information for key business processes."

A third chemical industry application is improving customer service. Reengineering can be used to figure out how to extend the boundaries of a supplier's technology and business functions so the customer can access select data at its convenience, rather than waiting for the supplier to meet that need. Providing that data is a way to enhance customer service and add a high margin of value.

FMC is currently piloting the reengineering process in one of its fast-growing businesses—its Marine Colloids Division. The business is one that has "developed in an entrepreneurial mode" and is now the size where "it needs new information technology to support continual growth," says Kramer. "We could implement new technology today, but what we would do is institutionalize what are perhaps invalid or old business practices and processes that first need to be challenged and changed."

The company is attacking that project from two angles: internal and external. On the external side, Kramer notes that FMC is looking at how it can grow to be a large organization and still remain the customers' most valued supplier. It is critically evaluating whether "we are easy to do business with" from the time a customer places an order until it receives the shipment. Internally, Kramer says it "is focusing on the way we do the jobs today and really challenging why certain work is performed."

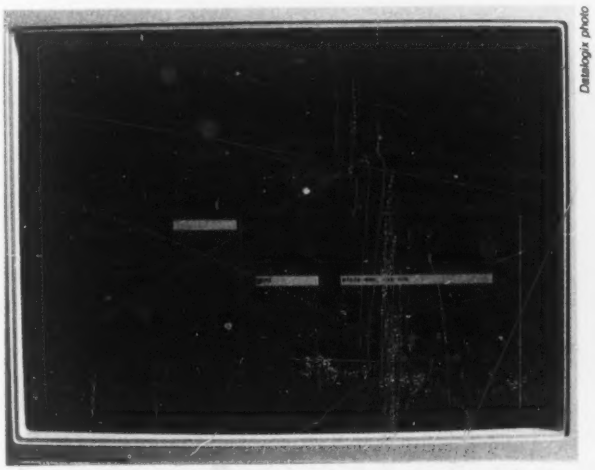
The benefits of reengineering don't come easy. It can take years to begin to understand how the new processes should work. And "people have to be really committed to the process of change and reengineering because you're increasing their work load significantly during that time frame," says Kramer. "Any reengineering effort needs to be driven by the organization who needs the change and not viewed as an information technology project. What we've encountered so far with the Marine Colloids Division is that 80% of what they're coming up with is really process related; only 20% is really information resource related." Besides the commitment of divisional employees, "you have to have commitment at the executive management level," he adds.

When the reengineered process is in place, and "we've challenged the status quo," the company needs to ask "how information technology can be used to institutionalize the better way of doing business," says Kramer. "Information technology becomes a facilitator in the process rather than the driver of the process," he adds.

The computer technology is what "enables us to make these [fundamental business] changes," says Nickles. For example, this technology makes it possible to do business processes in parallel, where they were done sequentially before. Or information technology allows a user to actually eliminate many of the steps in a process through automation.

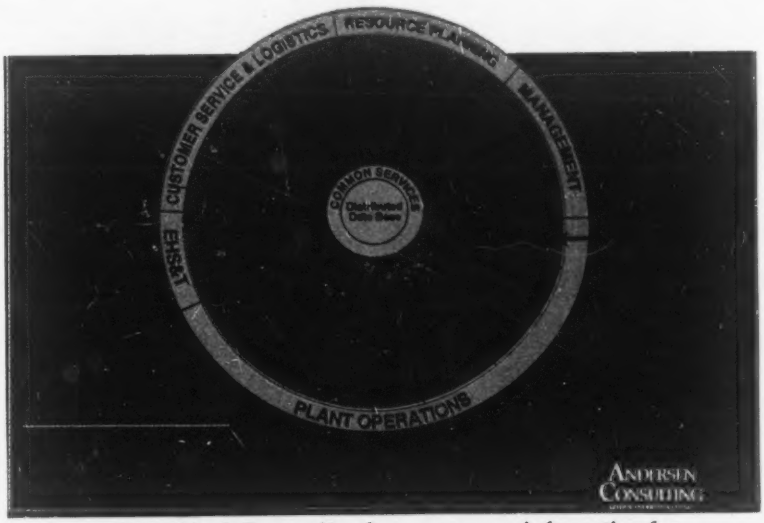
"So we are able to change the business processes in a very fundamental way," says Nickles, "through the use of information technology. The fundamental technology that will support the business process change brought on by reengineering is an integrated set of systems." In other words, when reengineering is completed by an organization, the next hurdle is integrating the systems they've deemed useful to their business.

Indeed, for several years now the chemical industry has been intensely focused on automating and integrating its plant operations, processes, and logistics systems. Many sys-



Datalogix photo

Datalogix's GEMMS Inventory Management Module gives paint inventory via location-lookup window



Andersen Consulting's Process/1 software manages information for applications areas shown in dial

tems have been installed individually. Distributed control systems, for example, tended to grow on their own as an application area; laboratory information management systems were largely built as individual applications, notes Rietzke. "So what you got were a series of applications" that developed independently of one another as "islands of automation." The problem comes when the laboratory wants to be able to access the data coming off of the process control system, for example. "If a company has invested in these individual applications over time and they still do good work, the company can't just throw them away and start over again, because that's just not economical," explains Rietzke.

The alternative is to integrate these islands so they can exchange information. "That's where we feel that a lot of the activity and interest is," says Rietzke. Making information available from one organizational structure to another is the main objective of the growing population of computer-integrated manufacturing (CIM) software programs. Although many of the software applications on the market are labeled as CIM systems, they are not all created equally. Everyone in the industry seems to define CIM differently, seeing systems integration from varying perspectives. Each system takes aim at certain parts of the CIM question, although there is some overlap among product capabilities.

One of those offerings is IBM's 18-month-old Process Operations Management System (POMS), which was developed by a consortium of five process manufacturing companies. The software application facilitates the electronic exchange of information among manufacturing resource planning (MRP), planning, other business systems, process control, and process operations. It accepts a production plan from MRP planning systems; automatically collects sensor, controller, and operator data; automatically reports back to MRP and other business systems; and reports back all production "actuals" to host-based systems, either in real-time or in batches, says IBM. POMS also allows companies to route other transactions or pieces of information on a real-time, dynamic basis around the network, says Rietzke.

Through the POMS Snap-on program, users can enjoy compatibility with an expanding library of software products for such applications as quality assurance lab management, equipment maintenance, statistical process control, and expert system analysis. Participation in the program by a growing list of third-party software vendors is making it easier for users to simply add features to their POMS system rather than add stand-alone systems, according to IBM.

POMS has other objectives, too. "It provides the ability to develop automated procedures on PCs to facilitate the execution of process orders and to collect process data as you get them," Rietzke adds. The product also enables companies to build historical relational databases that can be used in the management of the business. For example, POMS tracks data from process control, operators, quality assurance, and other sources. It also ensures and documents regulatory compliance.

IBM says POMS usage is picking up. During 1990, only a few companies besides the five that helped develop it were involved in pilot projects. In 1991, "there has been a steady stream" of new customers, says Rietzke. "Probably 25-plus customers are now in various stages of POMS implementation programs and roughly 20% of those are in the chemical industry."

Datalogix is another company that has entered the CIM arena. Its CIMPRO software solution, designed specifically for formula-based manufacturers, consists of an integrated set of programs covering a range of functions, including process manufacturing, computer-aided formulation, product costing, inventory, distribution, financial, accounting functions, and regulatory compliance applications. Its open systems environment allows various components to interoperate or exchange information. CIMPRO process software currently runs on Digital Equipment Corp. (DEC), Hewlett-Packard, IBM, Compaq, Bull Information Systems, and Unisys systems. Datalogix has strategic marketing partnership agreements with each hardware manufacturer. CIMPRO, which was introduced in 1981, is in place in more than 370 installations in diverse markets such as bulk and specialty chemicals, pharmaceuticals, printing inks, paints, textiles, specialty coatings, and adhesives.

Just this month, Datalogix has come out with its Global Enterprise Manufacturing Management System (GEMMS) product, which carries CIM one step further. GEMMS was written specifically to take the functionality that Datalogix built into CIMPRO and make it something that can be installed with many different systems at all of a corporation's different plants in their respective divisions so that all of that data can be "rolled up into one integrated whole for the corporation," says Arnold.

While CIMPRO operates at the plant level, the GEMMS CIM system operates on the enterprise level. Besides allowing for integration throughout the entire corporation, GEMMS offers support for multiple platforms, multiple languages, multiple currencies, European tax systems, and multilevel access to organizational information, for example. GEMMS is currently in the second stage of testing in five Fortune 500 companies, including Sun Chemical and Monsanto.

For its part, Andersen Consulting is taking aim at another part of the CIM puzzle. Recognizing that "a major disconnect exists today between the enterprise and process control systems," in late September, Andersen introduced another software product designed for use on an enterprise level called Process/1. According to Karl E. Newkirk, partner and product executive for Process/1 at Andersen, "Process/1 plugs this gap and provides the flexibility needed to help process manufacturers optimize their resources and improve customer response times."

The initial release of Process/1 is available on Digital VAX computers. Process/1's client-server architecture supports multinational operations and provides features such as multicurrency, multilanguage, and unit-of-measure conversion. Andersen says its product comprises five business application areas that are critical to today's process companies: plant operations; customer service/logistics; resource planning; product and financial management; and integration of environmental, health, safety, and training processes.

"As part of our strategic initiative to take advantage of new business opportunities, Process/1 will help us manage information more effectively and will enable us to respond quickly to changes in our market's demand," says Bruce Gordon, director of advanced systems operations at Geon Vinyl Division of B. F. Goodrich in Avon Lake, Ohio, which is currently installing the first release of Process/1.

"This is just the beginning," adds Drew Sellers, associate partner and product manager for Andersen. "Having addressed the critical plant and environmental needs in our initial release, we are hard at work developing enterprise-level applications including customer service/logistics, operations accounting, and resource planning for release in 1992."

There are many instances where big, global process companies can benefit from enterprise software, says Arnold. For example, a company like Datalogix client BASF can use such a system to keep tabs on the thousands of products it makes in hundreds of plants. Without this capability, there's a problem if one of its customers contacts a sales office in one of the divisions wanting to order certain quantities of magnetic tape, carpets, paint, and pharmaceuticals, for example. The customer wants to place the order for all these products, produced by different divisions, but the person taking the order may have no concept of the other groups' schedules. The easy thing for that representative to do is to help the customer with the representative's own product line and refer the customer to other divisions for their information.

But in today's competitive environment that's not good enough. Big multidivisional companies need to give their customers a single point of contact, so they can call a toll-free number, for example, and order any of the many products that the company produces. Enterprise systems, equipped with the power of a relational database, allow a representative to access information for any part of the corporation from a single location.

"We are trying to address what is the very toughest management problem: to centrally manage a huge business like a BASF," says Arnold. It is difficult to transmit corporate demand data down to the plants in a timely manner so that they can execute against it efficiently, and then get the plant's data back to the corporation's business center. "For example, if headquarters gave the plants

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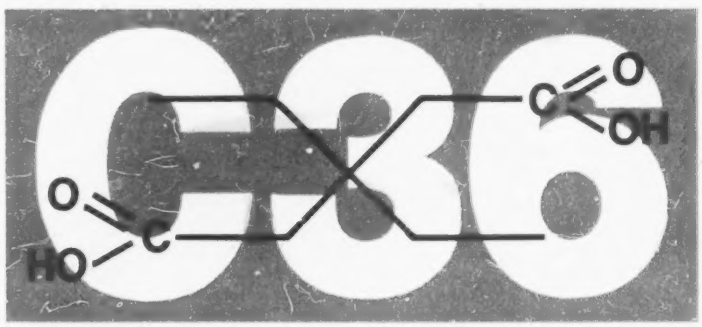

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their marching orders for the quarter and then its biggest customer requested a tremendous quantity of a new product, you really have to look at all the plants that can make that new product and reschedule from scratch to reoptimize." Enterprise systems help a corporation handle these types of situations, says Arnold.

Goodrich faced such a dilemma. What was critically lacking in Geon Vinyl's information management strategy was its ability to capture and integrate plant-level information, including shipping, receiving, production reporting, and most importantly, material control. "We needed a system that would allow us to accurately plan and schedule plant activities—what we'll call campaign management. It had to capture and exchange information with other systems (such as process control and enterprise) during the production process," says Gordon. Andersen's product is now helping it "to integrate information throughout the product development process and help the division better execute the campaign management phase of the production cycle."

Enterprise systems help companies to meet the key business challenges for any manufacturer such as staying close to customers worldwide, operating effectively as a global company, improving quality throughout the company, and getting products to market more quickly, says Arnold. He adds that enterprise software brings "really accurate, timely information where you need it so you don't have to search level after level to find it." And he predicts: "Enterprise software is the generation that is going to move CIM from an intriguing concept to a reality that contributes to bottom-line profits."

Indeed, for many companies, CIM still is nothing more than an intriguing concept. "Everybody is at least [dipping] a toe in the water, and there are some companies that have built advanced CIM plants," says Arnold. It is highly unlikely that any corporation has yet reached the enterprise mode, he adds.

Generally, CIM is still underutilized in the chemical industry, says Tim Challand, product technology manager of process manufacturing for M. W. Kellogg in Houston, which is in the business of developing systems integration solutions for process industry clients. One deterrent may be that implementing CIM at the plant level is a very challenging and time-consuming process.

But "the biggest problem we have in the industry right now is a credibility gap between promises of big savings and upper management's vision of where those big savings are. I don't know that the industry at large has been as good at tracking those benefits and just really showing management that those benefits have been achieved. And if [management] is not convinced of the benefits, then it makes it hard to justify the next expenditure," adds Challand.

Indeed, the benefits of CIM are many. From a product viewpoint, CIM allows companies to more quickly detect "off-spec production" and share that data "so that you can react to it. That's a benefit of CIM that impacts your bottom line because it means you'll be producing less waste," says Phares of Hoechst Celanese, which is implementing CIM at some of its plants.

From a productivity standpoint, CIM enables companies to capture accurate information in a way that allows everybody in that facility to use it at the same time. Without CIM it's conceivable that a single piece of information could be stored in several different places in a facility and vary "depending on whose file it was in," laments Phares.

The sharing of data through CIM also fosters "more of a teamwork environment in a facility." Interdepartmental lines are blurred when data are shared across the organization.

Slowly, chemical industry management is getting the message. Interest and utilization of CIM is picking up. Five years ago, although there were some pioneers in the CIM area, not everybody in the chemical industry felt that CIM was necessary to be competitive, says Challand. "But I don't see that now.

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"I think that most companies have been sold on [CIM] by so many different people that there's almost a mind-set now that if companies don't do this, they're going to be losing out," Challand says. Although management is getting "much more bottom-line oriented" in terms of cost-benefit analysis because of the current recession, "there's just a feeling that they need to go do this," he says.

The benefits of information technology in general are just too great to ignore, say chemical industry information technology managers. A number of factors are forcing the chemical industry to get on the information technology bandwagon and take it as far as it will go.

For one, increased federal, state, and local regulations have resulted in new record-keeping requirements. Because of the volume of detail and the rate at which technical and regulatory information changes, computer technology is the only practical way to maintain data on a current basis and access it efficiently. Collecting information and getting it to a company's own employees, its customers, vendors, transportation companies, and the government is a significant challenge to chemical companies, notes IBM's Rietzke. The Superfund Amendment & Reauthorization Act, for example, requires U.S. chemical manufacturers to report such items as the hazardous materials they use, the quantity used, and the day on which maximum use took place, says Datalogix's Arnold. "That is a hard thing to do without a computer."

Not surprisingly, environmental, safety, and health information systems are drawing "significant management interest in the chemical industry. These requirements are not new, but they are the subject of heavily increased focus," Rietzke says.

Aiming to capitalize on that interest, IBM has developed a new software product to help companies manage information about hazardous substances. Developed in conjunction with Eastman Kodak, IBM's International Chemical Datasheet System (ICDS) is a "comprehensive chemical information management program that allows companies to create, store, and distribute vital safety information wherever and whenever it is needed," says IBM. The product, which runs on a mainframe computer, offers multilanguage support, allowing material safety data sheets (MSDSs) to be created in multiple languages and multiple MSDS formats. When creating MSDS documents, users can rely on a multilanguage library of 1200 commonly used health and safety statements. The ICDS also features "on-demand MSDS queries that allow authorized users to retrieve MSDS forms quickly and easily from system terminals," says IBM.

The inability to collect the right regulatory data in a timely manner can have a big impact on the bottom line. "We had one customer who said it could sometimes develop new adhesives in its lab as fast as in four hours, but it was taking them at least one week to get the regulatory compliance data together. As a result, the company was losing business." Software solutions like CIMPRO can help chemical firms pull together the regulatory compliance data as quickly as they can develop their samples, says Arnold. With that software product, for example, that client "was able to ship the same day."

Andersen Consulting is also ready to exploit the keen interest in these applications. The consulting firm's new Process/1 systems integrates environmental, health, safety, and training processing with manufacturing operations, "providing automatic assists in complying with environmental regulations and promoting the health and safety of employees." Process/1 tracks the quantity and locations of hazardous ingredients in goods and materials and monitors the chemical exposure, medical history, training, and safety records of each employee. "With the onset of more stringent government regulations, the need to secure our employees' safety and to have complete control over any hazardous materials that move through our plants is critical," says Goodrich's Gordon.

The increasing demand of regulation has been one of the main driving forces behind Univar's $50 million investment in an IBM mainframe-based system called UVX 2000, says Alampi. The new system, slated to be completely installed by next April, enables the company to

standardize and control information in a central location so that its field staffers do not have to be individually updated on every new reporting requirement. For example, if a person in the field does not do bills of lading for hazardous materials on a regular basis, it would be relatively easy to skip something that is not required for other chemical shipments. "By coding that hazardous material in such as way so that whenever we sell that product, we generate the bill of lading that exactly meets the reporting requirement, or spell out exactly how it has to appear, the field people don't individually have to be brought up to speed on each reporting requirement," says Alampi.

"With larger systems, such as our UVX 2000, the opportunity also exists to introduce software that approaches the application of artificial intelligence in such a way that we can increase safety and regulatory compliance by substituting computer-maintained data on products and the regulations related to them, rather than attempting to rely on human memory," says Univar. "This assures us that it is done right the first time," Alampi explains. "The realm of environmental regulation has become so complex that the more we can standardize, the better off we're going to be. It's a critical point."

Information technology can also provide tools to better link together operations following mergers and acquisitions. After Univar doubled its size in 1986 by its acquisition of McKesson Chemical, the chemical distributor quickly realized that its existing system was inadequate. "We realized that we could not have adequate levels of control of information and understanding at all of our 106 locations unless we had a more centrally directed information system," notes Alampi. The new Univar system is designed to handle such tasks as order entry and warehouse handling and management for the corporation in an efficient manner.

Arnold believes that mergers and acquisitions are fueling the need for enterprisewide systems and open systems. "It's becoming too expensive to retrain people [on new systems] every time they move from department to department." And, for example, if a company sells a division that relies on DEC VAXs to another company that uses Hewlett Packard or IBM hardware, it's not practical to change one of the systems. "There's too much of an investment in hardware, software, and training. Nobody gets a clean sheet of paper. You need software that's going to run on all three vendor's platforms."

Another reason that chemical companies must embrace information technology is because it can help them improve service and thereby better attract and retain customers. An increase in partnering between manufacturer, distributor, and end user has opened up vast quantities of new information to both manufacturers and distributors. Computer-to-computer linkage within the distribution chain allows for dramatically increased levels of electronic data interchange between manufacturers, distributors, and product users, making possible programs such as automatic updating and transmission of MSDS and electronic mail, says Alampi. Electronic data interchange also opens the door for automatic purchasing, and for immediate distribution of information on new product applications to potential commercial users, he adds.

Just around the corner are plenty of new technologies that promise to help make the chemical companies that use them even more competitive. They keep evolving faster than chemical company information technology gurus can implement them. For one, Rietzke expects to see a consolidation of new technologies, such as image management and video, into applications that the customer can use. For that to happen, says Rietzke, "there's a lot of application software yet to be developed. But it will be an interesting future." Amoco's Valicenti agrees: "There are lots of possibilities out there. The future looks bright for implementation of information systems in the chemical industry." □

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